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J.Škriniarová, J. Kováč

Thick Photoresist Processing for Conductive Air Bridge Elements

4. MICRO- AND NANOELECTRONICS

Because of the continuing miniaturization of semiconductor devices and the need to contact small objects located close together a demand has arisen for conductive air-bridge element processing. The standard way for electrical connection of small elements is covering them with an insulator, drilling openings in appropriate places and filling them with metal for wiring. This process can be demanding and in such cases, non-supported air bridges are used for interconnection as alternative [1, 2]. This technique is of interest for manufacturers because of its low process costs and after optimization well-established technology.

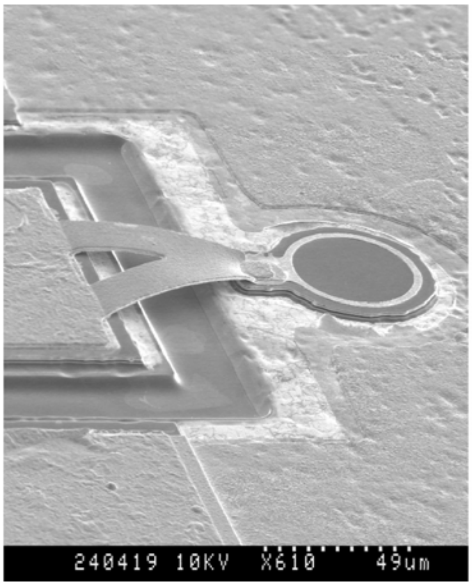

Fig.1 Scanning electron micrograph of a free-standing air-bridge with 70 µm length and 12µm width

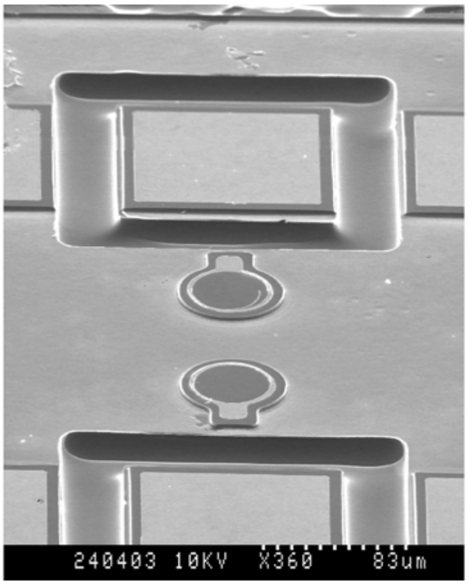

Fig.2 Scanning electron micrograph of mesa etched APD device and bonding pads

Non-supported air-bridges are usually fabricated by double patterning photolithography by using positive resist, metal evaporation and electroplating [3]. After active device mesa etching processes a thick layer of photoresist is spun onto the sample and patterned to open the metal pads on the mesa etched device. This step is very critical because it defines the height and form of the metal bridge and needs to be optimized. Onto the thick photoresist layer a thin metal coating is evaporated over the entire slice. The “preplated metal” serves to carry the electroplating current by forming the metal air bridge. Next, a second coating of photoresist is applied and patterned to open the air bridge stripe. The sample is then electroplated with thick metal layer to construct the air-bridge. Finally after the plating operation the top resist, thin metal, and lower resist are removed, leaving plated air-bridge (Fig.1).

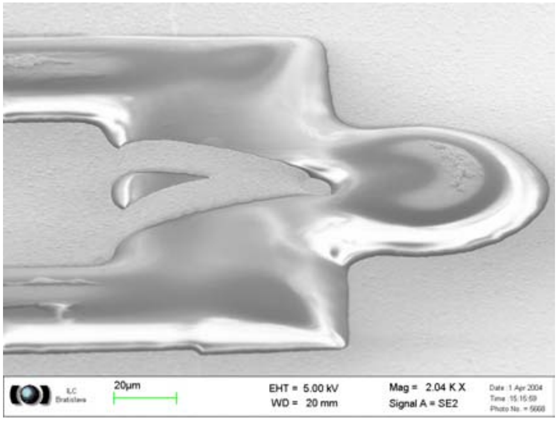

Fig.3 Overgrown air bridge metallization in photoresist

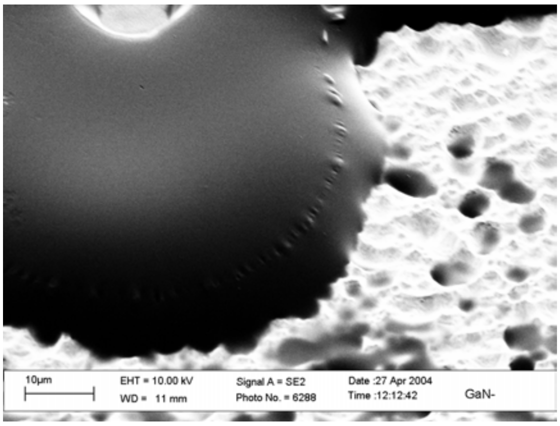

Fig.4 Detail SEM micrograph showing voids in photoresist

The aim of this contribution is to describe the impact and interaction of various parameters on the lithographic application results with focus on thick photoresist processing for non-supported air-bridge used for non-planar A_3B_5 semiconductor devices. We will describe difficulties arising during processing of thick photoresist for technology of avalanche photodiode (APD), where small pads and metallic areas for interconnection purpose are available (Fig.2). The mesa height of APD device is up to 8 µm with mesa diameter of 40µm. The design and processing will be illustrated with our experimental results. In our work we compare the conditions for thin and for 10 µm and thicker photoresist processing. The comprehensive analysis of thick photoresist processing was done by SEM investigations as shown in Fig. 3, 4. Another important fact has to be appreciated: if improper processing of thick resist occurs it can be found only after the whole technology process is completed.

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